PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F17332 LVDW	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/IB 03/02170	International filing date *(day/month/year)* 09.06.2003	Priority date *(day/month/year)* 10.06.2002
International Patent Classification (IPC) or both national classification and IPC B01J2/30		
Applicant RUSSEL-SMITH, KEVAN, VAUGHAN		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 7 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17.12.2003	26.07.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Van Iddekinge, R Telephone No. +49 89 2399-8346

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB 03/02170

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

3-5, 7-14	as published
1, 2, 6	received on 14.07.2004 with letter of 13.07.2004

Claims, Numbers

1-18	received on 14.07.2004 with letter of 13.07.2004

Drawings, Sheets

1-4	as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	16-18
Inventive step (IS)	Yes:	Claims	1-15
	No:	Claims	16-18
Industrial applicability (IA)	Yes:	Claims	1-18
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1). Reference is made to the following documents:

D1=US-A-3356520
D2=WO-A-00/00418
D3=GB-A-1090765

2). The normal cement and concrete mixing processes and also the process for making dough are process for densifying a bulk particulate material. D1, D2 and D3 also describe a method for densifying a bulk particulate material.

The method for densifying a bulk particulate material according claim 1 is novel because:
- The product of the dough making process, the product of the normal cement and concrete mixing processes are not a flowable bulk particulate material.
- D1, D2, D3 do not disclose the presence of an aqueous liquid densifying agent and vaporizing at least a portion of the aqueous liquid densifying agent.

Thus the subject-matter of claim 1 and its dependent claims 2-15 are novel in view of the available prior art (Article 33(2) PCT).

The examples in the application show that only small amounts of water (3%) are needed to increase the bulk density (of silica fume and carbon black) considerably (300%).
Only D1 and D3 are relevant for inventive step because these documents also disclose the use of a liquid densifying agent to densify a bulk particulate material. In D1 and D3 oil is used as a liquid densifying agent. In these documents 33.2% oil is needed to increase the bulk density 194.5 %. Thus the efficiency in D1 and D3 is much lower.

Therefore the subject-matter of claim 1 and its dependent claims 2-15 involve an inventive step in view of the available prior art (Article 33(3) PCT).

3). Since claims 16-18 do not contain any additional apparatus features that define

the specific inlets and outlets of the bulk particulate material and the densifying agent, any inlet may be used for adding the densifying agent and/or the bulk particulate material to be densified and any outlet may be used for the densifying agent and/or the densified bulk particulate material.

According to the present application the densifying agent (water) inlet may also function as a densifying agent outlet, see WO-A-03/103824: page 7, lines 13-14.

Every bakery has an apparatus for making dough. This apparatus comprises a vessel, mixing means (with rotatable means and drive means) and one or more inlets. In such an apparatus dough is prepared by mixing (densifying) flour (a bulk particulate material) with water and/or milk (a densification agent).

A normal cement and concrete mixing apparatus comprises a vessel, mixing means (with rotatable means and drive means) and one or more inlets. In such an apparatus cement/concrete is prepared by mixing (densifying) a bulk particulate material with water (a densification agent).

D1, D2 and D3 describe an apparatus for densifying a bulk particulate material. these apparatuses must comprise a vessel, mixing means (with rotatable means and drive means) and one or more inlets and outlets.

Thus the apparatus according to claims 16-18 lacks novelty in view of a dough making apparatus, in view of a normal cement and concrete mixing apparatus and in view of D1, D2 and D3 (Article 33(3) PCT).

DENSIFYING OF A BULK PARTICULATE MATERIAL

THIS INVENTION relates to densifying of a bulk particulate material. In particular, it relates to a method and to apparatus for densifying a bulk particulate material.

According to one aspect of the invention, there is provided a method of densifying a bulk particulate material to provide a densified flowable bulk particulate material, the method including mechanically agitating the bulk particulate material in the presence of a densification agent thereby to provide a flowable bulk particulate material of increased bulk density.

The densification agent is thus a liquid. It is however a feature of the invention that it is not necessary to remove the densification agent after having densified the bulk particulate material in order to obtain a flowable bulk particulate material. The densification agent is thus present or used in quantities small enough to ensure that the densified bulk particulate material remains flowable and does not form a slurry. The quantity of densification agent remaining in the densified flowable bulk particulate material is also so small that the mere presence of the densification agent in the densified flowable bulk particulate material does not materially alter the bulk density of the combined particulate material and the remaining densification agent. This bulk density is only changed to a significant extent by severely agitating the combined particulate material and the densification agent, without any significant agglomeration of the particulate material, or at least to a much lower degree of agglomeration than is reached with the prior art pneumatic densification processes of which the Applicant is aware.

The densification agent is thus an aqueous liquid, e.g. water or demineralised water.

The bulk particulate material, prior to densifying thereof, may include water in a mass concentration falling in a range with a lower limit of about 0.5 %. The lower limit may however be as low as about 0.45 %, or even as low as about 0.4 %. An upper limit of the range may be as high as about 10 %, or even higher at about 15 %, or even as high as about 20 %.

It is however to be appreciated that the bulk particulate material being densified may affect the effective range within which an aqueous densification agent can be used. The aforementioned ranges are however suitable for the densification of microsilica, such as silica fume.

The bulk particulate material may be a hygroscopic material. The bulk particulate material may be microsilica, e.g. fumed silica, precipitated silica, colloidal silica or silica gel.

Instead, the bulk particulate material may be selected from the group consisting of carbon black, fly ash, kaolin, and meta kaolin. Also, the bulk particulate material may be selected from the group consisting of Mn_2O_3, Mn_3O_4, V_2O_5, cement and slag.

When the bulk particulate material is particulate silica, the particulate silica may have a particle size of the less than 0.5 μm, typically less than 0.2 μm. Indeed, it is expected that the invention will find particular, though not exclusive application in densifying so-called silica fume.

The method may include adding the densification agent to the bulk particulate material, prior to or during mechanical agitation of the bulk particulate material.

The bulk particulate material may have a mean particle size of less than 1 mm. Typically, the bulk particulate material has a mean particle size of less than 0.5 mm, even less than 1 µm, e.g. about 0.15 µm.

The method may include extracting dust from the vessel.

The ratio of the bulk density of the particulate material prior to densifying thereof, to the bulk density of the flowable densified particulate material may be at least 2 : 3. Preferably, the ratio of the bulk density of the particulate material prior to densifying thereof, to the bulk density of the flowable densified particulate material is at least 1 : 5, depending on the bulk density of the particulate material prior to densifying and the particulate material being densified. The ratio can be as large as 1 : 10, or even larger, e.g. 1 : 12 depending on the bulk density of the particulate material prior to densifying and the particulate material being densified.

The method may include allowing the concentration of the densification agent to reduce during the mechanical agitation of the bulk particulate material.

Thus, typically, the bulk particulate material is allowed to heat up during the mechanical agitation thereof. The concentration of the densification agent may thus be reduced as a result of vaporization of at least a portion of the densification agent.

The bulk particulate material may include water in, or water may be added to the bulk particulate material to, a concentration of more than 4 % by mass, with the densified bulk particulate material including less than 3 % water by mass. Typically, especially when the bulk particulate material is microsilica, the bulk particulate material includes water in, or water is being added to the bulk particulate material to, a concentration of between 4 % and 8 % by mass, preferably between 6 % and 8 % by mass, with the densified bulk particulate material including less than 1.5 %, preferably less than 1 %, water by mass.

CLAIMS:

1. A method of densifying a bulk particulate material to provide a densified flowable bulk particulate material, the method including

mechanically agitating the bulk particulate material in the presence of an aqueous liquid densification agent; and

allowing the concentration of the aqueous liquid densification agent to reduce during the mechanical agitation of the bulk particulate material by allowing the bulk particulate material to heat up as a result of the mechanical agitation and vaporizing at least a portion of the aqueous liquid densification agent, thereby to provide a flowable bulk particulate material of increased bulk density.

2. The method as claimed in claim 1, in which the bulk particulate material, prior to densifying thereof, includes water as the densification agent in a mass concentration falling in a range with a lower limit of 0.4 % and an upper limit of 20 %.

3. The method as claimed in claim 2, in which the water is present in a range with a lower limit of 0.45 % and an upper limit of 15 %.

4. The method as claimed in any one of the preceding claims, in which the bulk particulate material is microsilica.

5. The method as claimed in any one of claims 1 to 3 inclusive, in which the bulk particulate material is selected from the group consisting of carbon black, fly ash, kaolin, and meta kaolin.

6. The method as claimed in any one of claims 1 to 3 inclusive, in which the bulk particulate material is selected from the group consisting of Mn_2O_3, Mn_3O_4, V_2O_5 and slag.

7. The method as claimed in claim 4, in which the microsilica has a particle size of less than 0.5 μm.

8. The method as claimed in any one of the preceding claims, which includes adding the densification agent to the bulk particulate material, prior to or during mechanical agitation of the bulk particulate material.

9. The method as claimed in any one of the preceding claims, in which mechanically agitating the bulk particulate material in the presence of the densification agent includes at least partially confining the bulk particulate material and rotating a rotatable member submerged under the bulk particulate material about an axis of rotation to cause severe agitation of the material.

10. The method as claimed in any one of the preceding claims, in which mechanically agitating the bulk particulate material in the presence of the densification agent includes severely agitating the bulk particulate material with a rotatable member submerged in the bulk particulate material in a vessel and rotating about an axis of rotation which is upwardly extending, and inhibiting displacement of material downwardly past the rotating member during rotation of the rotatable member whilst allowing free movement of materials in the vessel above the rotating member.

11. The method as claimed in claim 9 or claim 10, in which the bulk particulate material is confined in a vessel having a closed bottom, the rotatable member being located immediately above the bottom of the vessel.

12. The method as claimed in any one of the preceding claims, in which a ratio of the bulk density of the particulate material prior to densifying thereof, to the bulk density of the flowable densified particulate material is at least 2 : 3.

13. The method as claimed in claim 12, in which the ratio of the bulk density of the particulate material prior to densifying thereof, to the bulk density of the flowable densified particulate material is at least 1 : 5.

14. The method as claimed in any one of the preceding claims, in which the bulk particulate material includes water in, or water is being added to the bulk particulate

material to, a concentration of more than 4 % by mass, with the densified bulk particulate material including less than 3 % water by mass.

15. The method as claimed in claim 14, in which the bulk particulate material includes water in, or water is being added to the bulk particulate material to, a concentration of between 4 % and 8 % by mass, with the densified bulk particulate material including less than 1.5 % water by mass.

16. Bulk particulate material densification apparatus for densifying a bulk particulate material to provide a densified flowable bulk particulate material, the apparatus including

a vessel for at least partially confining a body of the bulk particulate material;

a rotatable member which is arranged such that in use it is submerged in the body of bulk particulate material mechanically severely to agitate the bulk particulate material;

a densification agent inlet leading into the vessel;

a densification agent outlet leading from the vessel to remove vaporized densification agent; and

drive means connected to the rotatable member and capable of rotating the rotatable member about said axis of rotation when the rotatable member is submerged in the body of bulk particulate material.

17. Bulk particulate material densification apparatus for densifying a bulk particulate material to provide a densified flowable bulk particulate material, the apparatus including

a vessel for at least partially confining a body of the bulk particulate material;

a rotatable member which is arranged such that in use it is submerged in the body of bulk particulate material mechanically severely to agitate the bulk particulate material;

a densification agent outlet from the vessel to remove a vaporized densification agent from the vessel; and

drive means connected to the rotatable member and capable of rotating the rotatable member about said axis of rotation when the rotatable member is submerged in the body of bulk particulate material.

18. Bulk particulate material densification apparatus as claimed in claim 16 or claim 17, in which the rotatable member defines at least one material contacting surface facing substantially tangentially in the direction of rotation thereby to cause movement of material particles essentially towards or away from the axis of rotation at least on initial contact of the material particles with the material contacting surface.